

# PATENT SPECIFICATION

887,798

DRAWINGS ATTACHED.

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## COMPLETE SPECIFICATION.

### Respirator Belt.

We, CONITECH, LTD., a Corporation organized and existing under the laws of the State of New York, United States of America, having a place of business at Old Saw Mill River Road, Chauncey, New York, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates, in general, to improvements in artificial respiration apparatus and, in particular, to improvements in artificial respiration apparatus of the portable type which is adapted to fit over the frontal portion of the patient's abdominal and higher regions.

Prior art abdominal belts caused the phenomenon known as paradoxical breathing. In such breathing there is an expiratory motion in abdominal breathing and an inspiratory motion in the intercostal breathing because the inflated belt depresses the viscera and pushes up the diaphragm of the patient. This is an expiratory movement but at the same time the raising of the patient's diaphragm tended slightly to raise the rib cage which, in turn, caused an inspiratory movement.

The present apparatus is constructed so as to obviate or greatly minimise paradoxical breathing.

According to the present invention, there is provided artificial respiration apparatus comprising a belt provided with a flexible casing adapted to be fitted over the frontal portion of the patient's abdominal region, means for releasably securing said casing about the body of the patient in said position, said casing having provision to permit

the passage of fluid under pressure into and out of the casing for rhythmically expanding and contracting the latter when the casing is secured about the body of the patient in said position, characterised in that said casing is adapted to extend upwardly from the groin of the patient to a point above the lower ribs and the belt has a rear panel which is adapted to extend upwardly from the coccyx of the patient to a point above the lower ribs, whereby the lower rib cage of the patient is covered to prevent paradoxical breathing, said rear panel being stiffened to support the back muscles of the patient.

An embodiment of the invention will now be described with reference to the accompanying drawings in which:—

Fig. 1 is a front view of an abdominal belt, formed according to the present invention, shown in position on a patient;

Fig. 2 is a rear elevational view of the abdominal belt shown in position on a patient;

Fig. 3 is a view in elevation of the rear panel of the abdominal belt looking at the inner surface thereof;

Fig. 4 is a view in elevation of the front panel of the abdominal belt looking at the outer surface thereof;

Fig. 5 is a view in elevation of the bladder utilized in the abdominal belt of the present invention;

Fig. 6 is a sectional view, on an enlarged scale, taken on the line 6—6 of Fig. 1;

Fig. 7 is a fragmentary detail view taken in the area of arrow 7 of Fig. 3 showing the opposite surface of the indicated area of Figure 3;

Fig. 8 is a sectional view on an enlarged scale, taken on the line 8—8 of Fig. 1; and

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Fig. 9 is a sectional view on an enlarged scale taken on the line 9—9 of Fig. 4.

Referring now to the drawings in detail, there is shown an abdominal belt 10, pursuant to the present invention, for producing artificial respiration in body encircling relation on the patient P, said abdominal belt being adapted to be operatively associated with a suitable respirator pumping apparatus for rhythmically varying the air pressure applied to the abdominal belt. Said pumping apparatus may be of any suitable type and is preferably of the type illustrated and described in British Patent No. 764,589. As hereinafter described in detail, the abdominal belt respirator 10, which is adapted to be disposed on the patient in body form encircling relation, comprises a front panel 12 constituted by a casing 14, which is adapted to receive an inflatable bladder 32 and is adapted to be fitted over the front portion of the patient's abdominal region, and a rear panel 17 which is adapted to be secured to the front panel 12 and fitted over the back of the patient. The bladder 32 in the casing 14 is adapted to have the air pressure therein rhythmically varied by means of the described air pump for inducing artificial respiration.

The front panel 12 is formed of superposed outer and inner layers 16 and 18 respectively which are formed of a flexible fabric material, for example, a suitable textile fabric. The inner or body engaging layer 18 is formed of a softer fabric material than the outer layer 16, said layers constituting the casing 14 and defining a pocket 20 therebetween. The layers 16 and 18 are secured together along the upper and lower edges 22 and 24, respectively, thereof as by the stitching 26 which also serves to secure a reinforcing or finishing strip 28 about the outer layer 16. The pocket 20 is open at the opposite ends 30 thereof, as best shown in Fig. 8 for the insertion and removal of the bladder 32 therefrom.

The bladder 32, which may be formed of any suitable flexible fluid impervious material, for example rubber, synthetic plastic or the like, comprises a pair of opposing walls 34 and 36 which are shaped as best shown in Fig. 5. More specifically, the upper edge 38 of the bag is linear but the bottom and side edges thereof have curved or arcuate conformation, as indicated at 40, to provide a relatively deep and wide bladder adapted to extend from the groin of the patient upwardly sufficiently to cover the lower part of the rib cage which is generally indicated by the reference numeral 42, as best shown in Figure 6. In order to secure the bladder 32 in position in the pocket 20 of the casing 14, the bladder is provided with the flaps 44 which are formed preferably of the same material

as the bladder and which extend laterally from the wall 36 thereof, as best shown in Fig. 5. Each flap 44 is provided with a pair of snap fastener elements 46 releasably engaged with companion snap fastener elements 48. It will be apparent that the companion snap fastener elements 46 and 48 releasably secure the bladder in the pocket 20.

In order to inflate and deflate the bladder 32, provision is made for a tube 50 which extends from the bladder through a slit or opening 52 which is defined in the outer layer 16 of the front panel. It will be understood that the tube 50 is permanently affixed to the bladder at one end thereof and is provided at the opposite end thereof with a bayonet connection 54 to a suitable air conduit from the respirator pumping apparatus.

It will be noted that the front panel 12 has a conformation complementary to that of the bladder 32, as best shown in Fig. 4. In this connection, it will be noted that the upper edge 58 of the front panel is linear and that the bottom edge 60 thereof is curved or arcuate and that the vertical extent of the front panel is such that in use the lower edge 60 thereof is substantially at the patient's groin and the upper edge 58 thereof covers the lower part of the rib cage 42 of the patient, as best shown in Figure 6. In order to rigidify the front panel 12 so that the pressure of inflation of the bladder 32 will be applied to the patient's abdominal region from the groin up to an area overlying the rib cage, so as to cover the lower part of the rib cage, there are provided three vertically extending inner stays 62 and a pair of outer stays 64. Each of the stays 62 is non-removably disposed in a complementary pocket 66 defined by strips 68A, 68B and 68C secured to the outer layer 16 of the front panel. The intermediate stays 62 are substantially vertically disposed and the outer stays 64, at the opposite sides of the intermediate stays 62, are disposed at outwardly flaring angles relative thereto. The outer or endmost stays 64 are each disposed in a pocket defined by a strip 70 suitably secured, as by sewing to the outer surfaces of the front layer 16, it being noted, however, that the pockets for the stays 64 are closed at the bottom thereof but are open at the top thereof as at 71. This permits the ready removal of the outer stays 64 from the complementary pockets as may be required. It sometimes occurs that with certain patients the bottom ends of the outer stays 64 may cut into the patient's hipbone. If this should occur, the outermost stays 64 can be raised or partially withdrawn from the associated pockets, as shown for example in the left hand stay 64 in Figure 4,

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to a point where the outer stays 64 will no longer cut into the patient's hipbone. The portion of the stay 64 extending from the open end 71 of the associated pocket can then be removed, as by cutting, and a seam can then be sewn across the pocket at the bottom of the raised stay 64 to prevent the return of the stay to the bottom of the pocket.

In order to mount the belt 10 about the patient's body, as hereinafter described in detail, the front panel 12 is provided with the three fabric strips or tapes 72A, 72B and 72C which are suitably secured at the front surface thereof and extend transversely of the three pocket defining strips 68. Each of the strips 72 is provided with a first buckle 74 between the center pocket defining strip 68A and the associated pocket defining strip 68C and with a second buckle 76 between said latter strip 68C and the adjacent strip 70. Each strip 72 is also provided with a first hook 78 between the central pocket defining strip 68A and the associated pocket defining strip 68B and with a second hook 80 between said latter strip and the adjacent pocket defining strip 70, as will be readily apparent from Fig. 4. The functions of said buckles and hooks are hereinafter described in detail.

The rear panel 17 is also formed of flexible sheet material, preferably a textile, being formed of the same material as is the outer layer 16 of the front panel. The rear panel 17 has a vertical extent from the coccyx to nearly the shoulder blades. It will be noted that the vertical or longitudinal extent of the rear panel is greater than that of the front panel, as will be readily apparent from Figure 6. Along its upper and lower edges 81 and 82, respectively, the rear panel is provided with the finishing strips 84 and 86 which are suitably secured thereto, preferably as by a sewing operation. The rear panel is also provided with a plurality of vertically extending spaced parallel stays or supports 87, which are similar to the previously mentioned stays 62 and 64 and which are suitably positioned within pockets defined by fabric strips 88 suitably secured to the underlying fabric of the rear panel 17, as best shown in Figs. 2 and 3.

It will be noted that provision is made for the stays 87A and 87B at each of the opposite ends of the rear panels, and inwardly of each of said stays, a strip 89 is secured to the panel and stitched thereto to define loops 92, the function of which will presently appear. At the end 94 thereof, the panel 17 is provided with three straps 96 and at its opposite end 98 the panel is provided with two straps 100 and with a band 102 from which there extends the strap 104. The provision of the band

102 separated from the end 98 of the panel 17 improves the fit of the belt on the wearer. The straps 96 are each provided with a buckle 106 which is adjustable longitudinally of the associated strap. Each buckle 106 is provided with an eyelet 108 whereby each buckle 106 is adapted to be releasably engaged with an associated one of the previously mentioned hooks 78 or 80, as the case may be, for securing the adjustable length strap 96 of the rear panel to the front panel. It will be readily apparent that through the provision of the adjustable buckle 106 and the laterally spaced hooks 78 and 80 associated with each buckle, the belt 10 can be secured at one side of the patient's body and the size thereof adjusted to the patient's. In order to effect the securement of the belt at the other side of the patient's body, and also to further assist in properly adjusting the belt to the patient's girth and to properly fit the belt about the patient's body, each of the straps 100 and 104 may be readily threaded and secured into one of the associated buckles 74 and 76, as the case may be, and threaded through loop 92 as will be readily apparent.

When worn about the body of a patient, the belt is positioned on the patient as best shown in Figs. 1, 2 and 6. It will be noted that the belt extends both at the front and rear of the patient's body from the groin or hip area upwardly so as to also cover the lower part of the rib cage 42 of the patient. Due to the shape of the front and rear panels, as shown in Figs. 3 and 4 the belt extends transversely so as to also cover the desired region of the lower part of the rib cage.

Paradoxical breathing is minimized by the abdominal belt of the present invention due to the fact that it covers the lower rib cage area of the patient so that when the bladder 32 is inflated, the rib cage is not raised. In addition, by extending the vertical extent of the belt, especially at the back thereof from the hip to a point where the lower part of the rib cage is covered, and by providing for the stays 87 in the rear panel, greater support is provided for the back muscles of the patient. This is accomplished by a distribution of the pressure of the belt over a greater area of the patient's back so that there is present a lower or decreased amount of pressure per unit area at the back of the patient's body, while at the same time the total pressure at the patient's back is increased to a much greater point than was heretofore possible with belts of the prior art. Further, with two vertical rows of hooks 78 and 80, as well as two vertical rows of buckles 74 and 76, in combination with the adjustable buckles 106 on the straps 96, the belt can be adjusted

to fit a large number of patients with a great variance in girth, so as to eliminate the necessity for stocking various belts of different sizes. In ordinary use, the belt will be removably secured to the patient and removed by engagement of buckles 106 with hooks 78 and 80 and by disengagement from said hooks.

As previously indicated, the bladder 32 will be inflated and deflated through the action of a respirator pump which provides both suitable positive and negative pressures to the bladder 32 through the conduit 50. The degree of inflation and deflation and the rate of alternations between such inflation and deflation may be controlled at the respirator pump in a well known manner. The belt respirator 10 facilitates the breathing of the patient by applying pressure in the abdominal region and over the lower part of the rib cage during the period when the bladder is inflated and the pressure of inflation against the abdomen results in the lifting of the patient's diaphragm which takes place during the expiration phase of the induced artificial respiration cycle, it being noted in this connection that due to the fact that the belt covers the lower part of the rib cage, the latter is not raised when the bag is inflated and therefor paradoxical breathing is reduced. When the bladder is deflated, the diaphragm is correspondingly lowered to permit air to enter the lungs and this occurs in the inspirational phase of the artificial respiration cycle. The diaphragm is constituted by a movable sheath and when the diaphragm is lowered the thoracic space increases so as to permit air to enter the lungs, this occurring in the inspirational phase of the respiration cycle. Similarly, when the diaphragm is raised, the thoracic space is decreased and causes air to discharge from the lungs, this occurring during the expirational phase of the respiration cycle. The amount of excursion of the diaphragm will determine to a degree the volume of air entering and leaving the lungs and the greater the amount of excursion the greater will be the air exchange. It will be apparent that if the patient has paralyzed abdominal muscles he will be unable to expand and contract the abdominal space and so cannot control the movement of the diaphragm and, in such case, the respirator 10 can aid the patient in breathing in the manner described above. Thus, by rhythmically inflating the bladder 32 of the respirator 10 the patient's abdomen is rhythmically acted upon so as to contract the abdominal space and raise the diaphragm to effect expiration. With the release of the inflation pressure the diaphragm is permitted to assume the inspiratory position. The front panel 12 is of a vertical extent to extend substantially upwardly from the pubic

crest of the patient to above the bottom ribs so as to cover the lower part of the rib cage, the rear panel 17 similarly extending from the region of the hips to a point above the lower ribs to cover the lower part of the rib cage so as to reduce paradoxical breathing, as previously described.

The respirator belt of the present invention is not only useful in cases of paralyzed or impaired abdominal muscles but also may be of help in other cases, for example in cases of difficulty in expiration in emphysema cases. As used in the claims, the term abdominal region includes the abdominal region and also the region of the lower part of the rib cage.

#### WHAT WE CLAIM IS:—

1. Artificial respiration apparatus comprising a belt provided with a flexible casing adapted to be fitted over the frontal portion of the patient's abdominal region, means for releasably securing said casing about the body of the patient in said position, said casing having provision to permit the passage of fluid under pressure into and out of the casing for rhythmically expanding and contracting the latter when the casing is secured about the body of the patient in said position, characterised in that said casing is adapted to extend upwardly from the groin of the patient to a point above the lower ribs and the belt has a rear panel which is adapted to extend upwardly from the coccyx of the patient to a point above the lower ribs, whereby the lower rib cage of the patient is covered to prevent paradoxical breathing, said rear panel being stiffened to support the back muscles of the patient.

2. Artificial respiration apparatus according to Claim 1, further characterised in that the stiffened back panel has a plurality of vertically extending spaced stiffening strips extending from the top to the bottom of the back panel.

3. Artificial respiration apparatus according to Claim 2, further characterised in that the back panel is adjustably connected to the front part of the casing.

4. Artificial respiration apparatus according to Claim 1, 2 or 3, further characterised in that the frontal casing has a lower convexly curved marginal edge and an upper linear marginal edge.

5. Artificial respiration apparatus substantially as hereinbefore described with reference to and as shown in the accompanying drawings.

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Reference has been directed in pursuance of Section 9, subsection (1) of the Patents Act, 1949, to Patent No. 783,671.

Fig. 1.

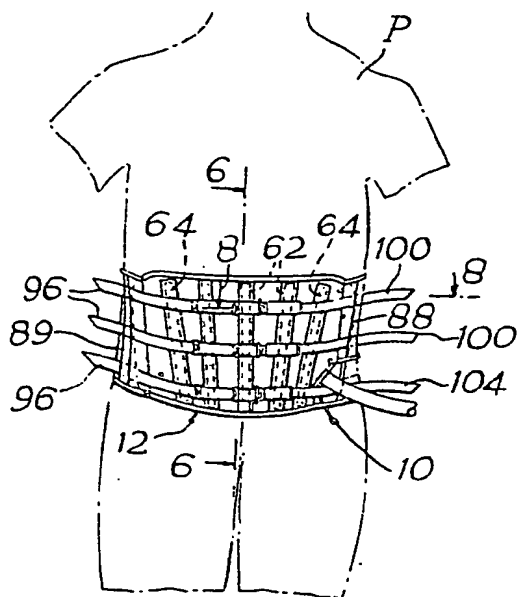


Fig. 2.

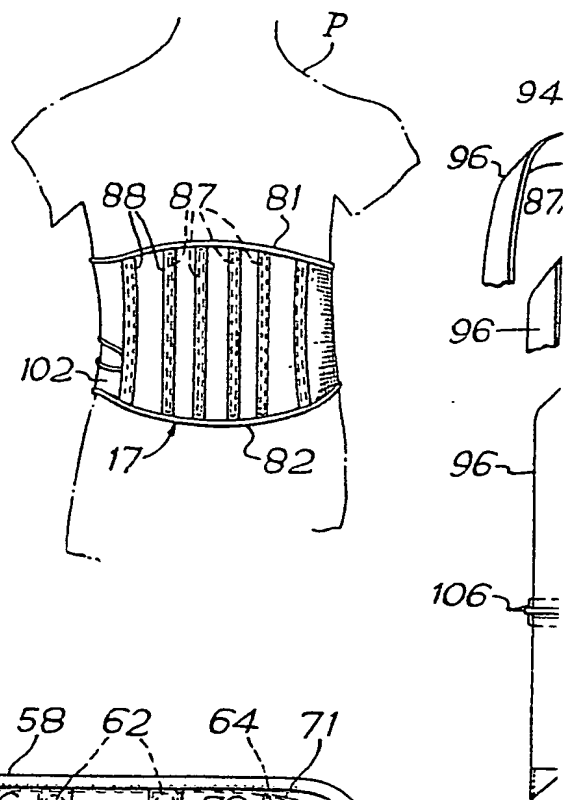
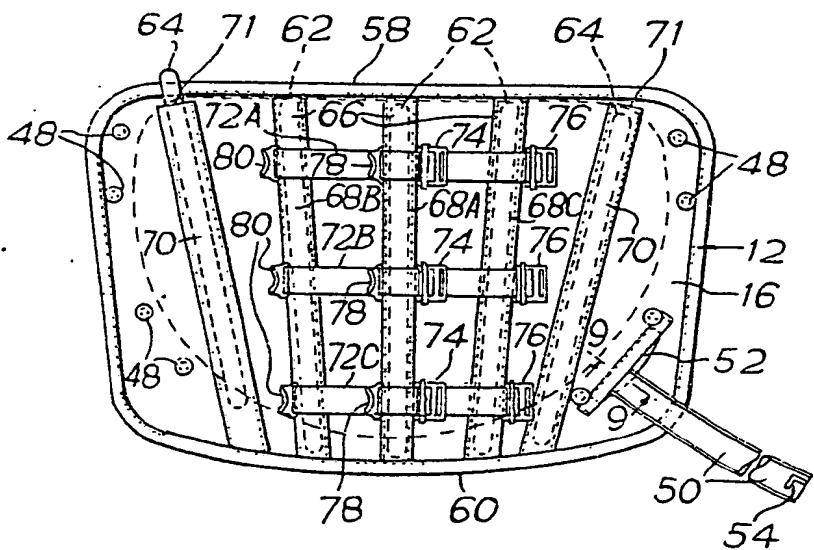


Fig. 4.



2 SHEETS

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**SHEET 1**

*Fig. 3.*

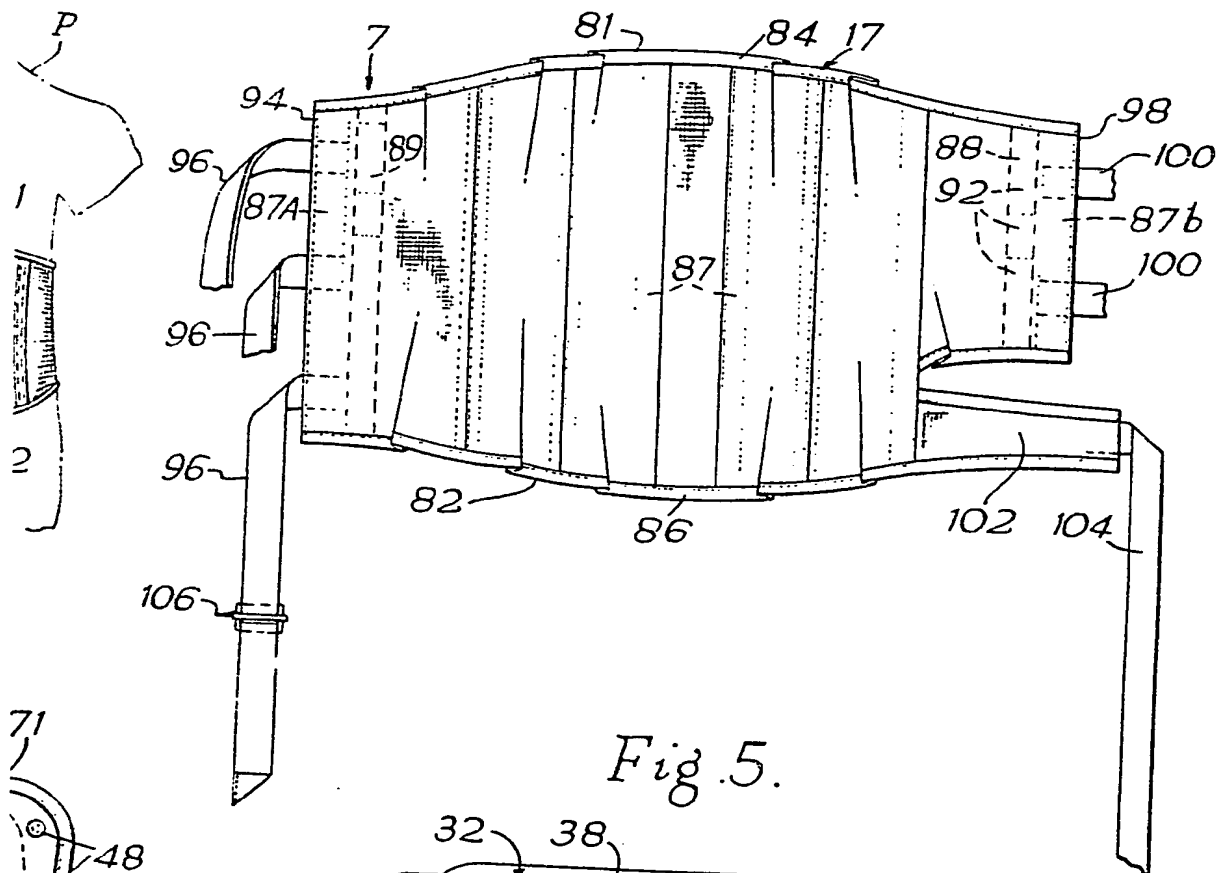


Fig. 5.

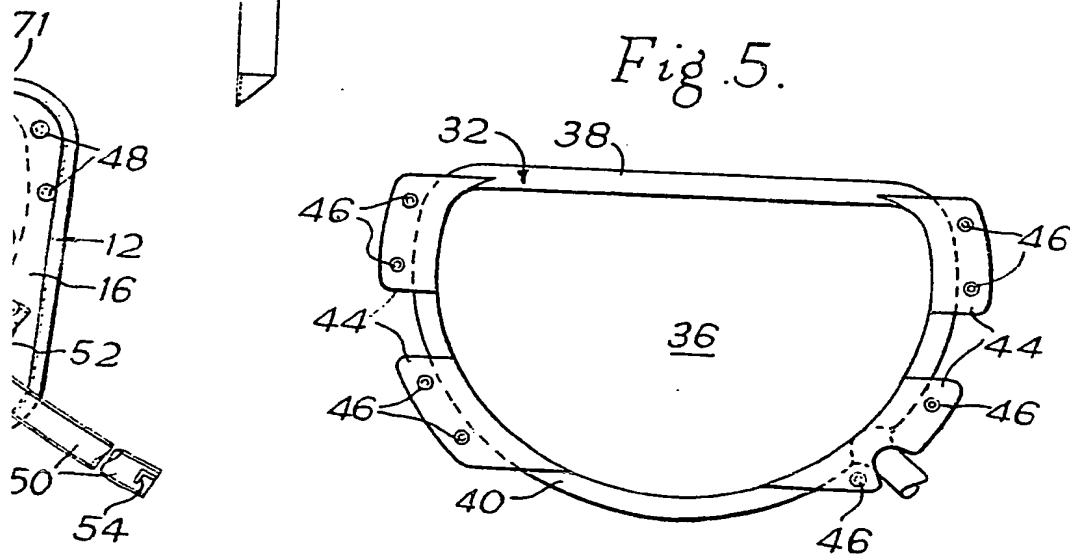


Fig. 1.

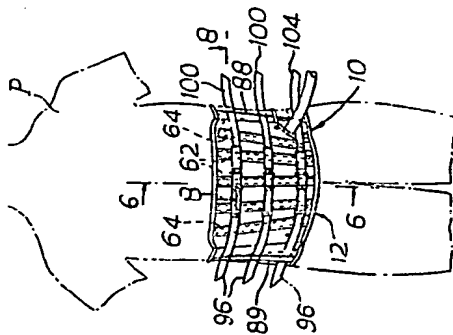


Fig. 2.

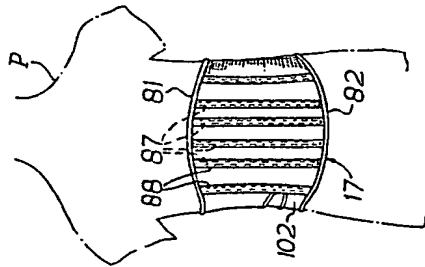


Fig. 3.

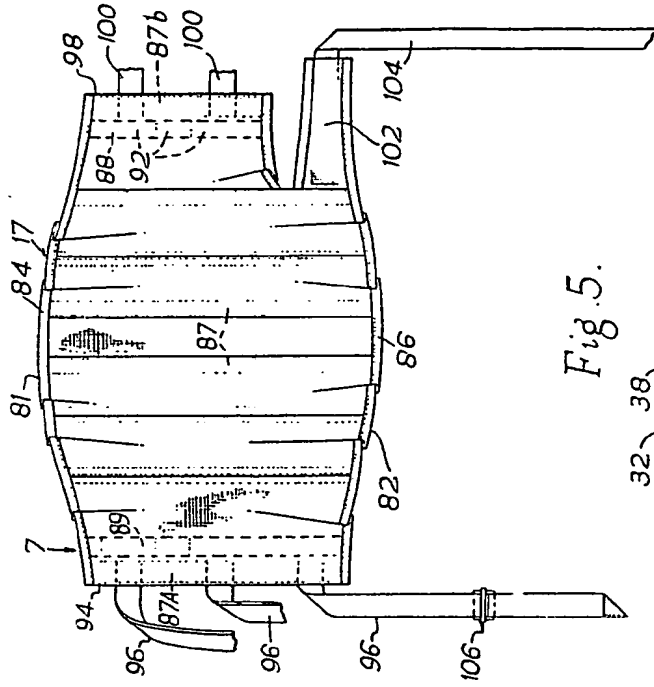


Fig. 4.

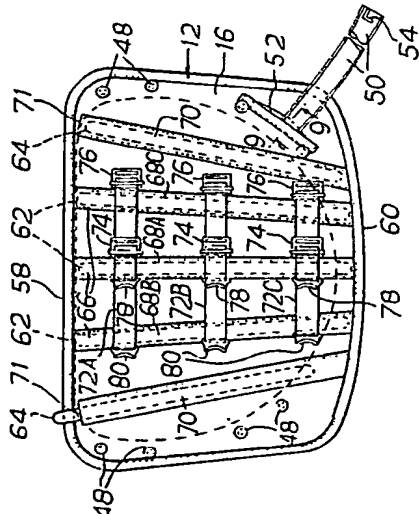


Fig. 5.

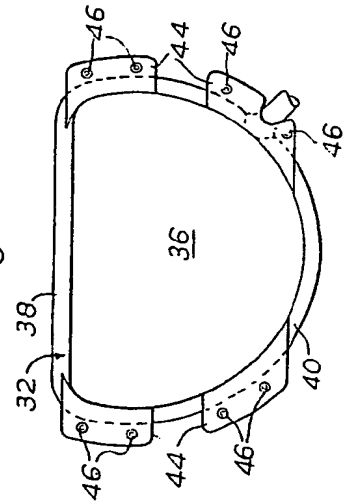


Fig. 6.

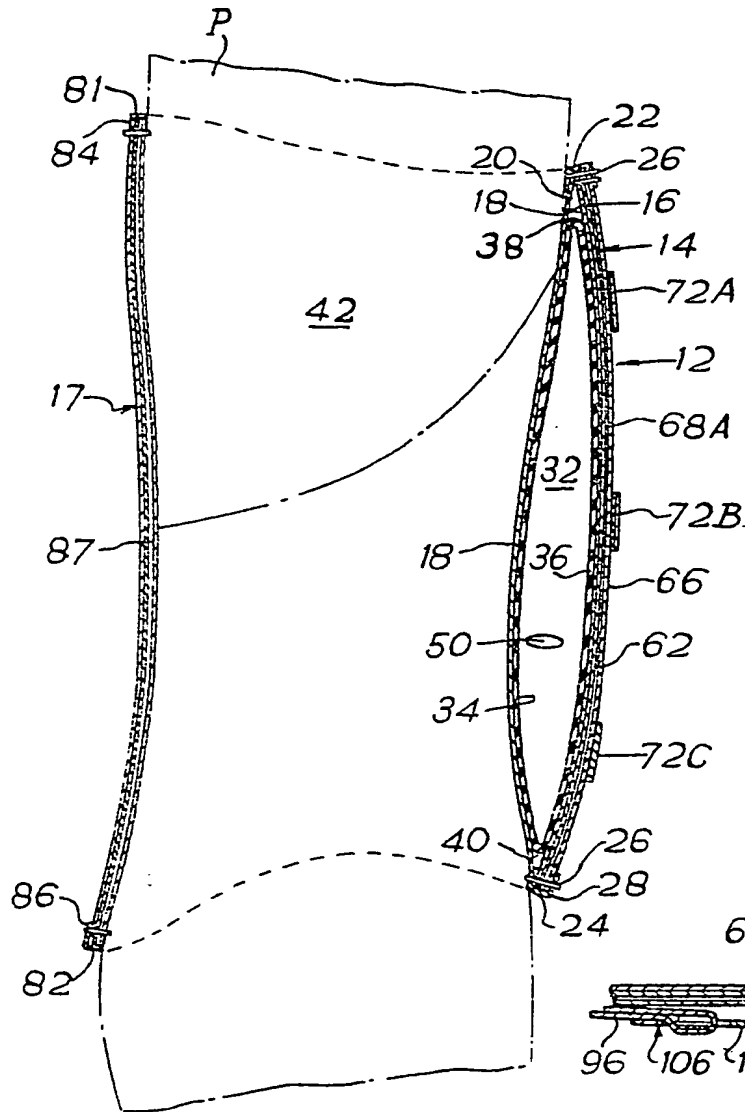


Fig. 7.

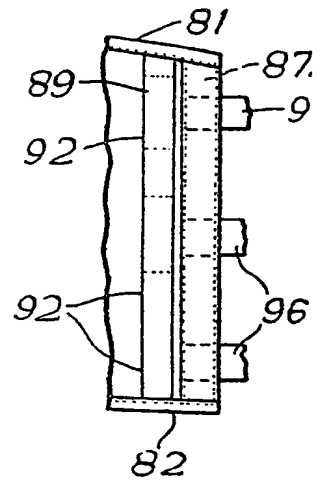
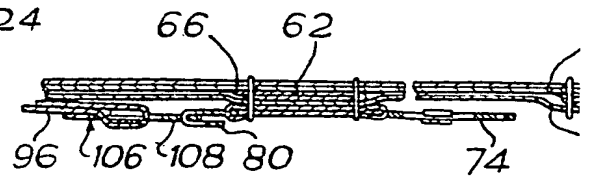


Fig. 8.





887,798  
2 SHEETS

COMPLETE SPECIFICATION

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SHEET 2

Fig. 7.

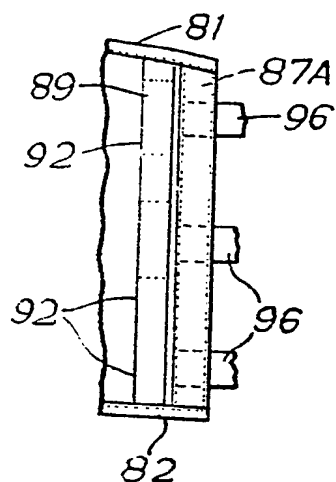


Fig. 9.

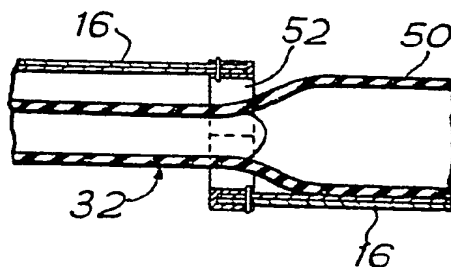


Fig. 8.

